

THE CHOCOLATE INDUSTRY
By
Donald G. Mitchell

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2065

Chocolate indust



American Industries

The Chocolate Industry

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Research Chemist

Walter Baker Chocolate & Cocoa Division

General Foods Corporation



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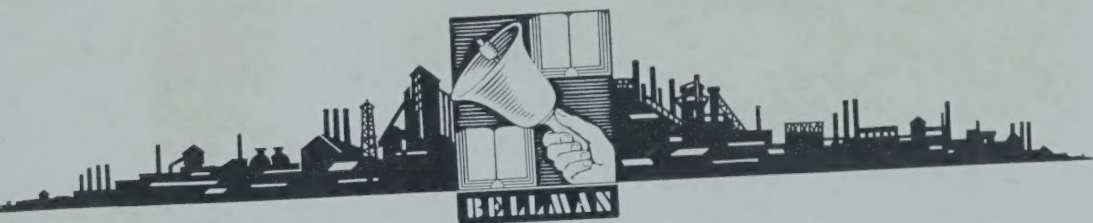
Research Chemist

Walter Baker Chocolate & Cocoa Division
General Foods Corporation

No. 17

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One Dollar

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Chocolate indust...

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The Author



STARTING as a Research Assistant, the author began his career on completion of college in the chocolate industry in the employ of Walter Baker & Company, Inc. (now Walter Baker Chocolate and Cocoa Division of General Foods Corp.) of Dorchester, Massachusetts. Because of the diversity of problems encountered in research work, this was an excellent position in which to build a good knowledge of chocolate and its manufacture.

During World War II Mr. Mitchell, being a member of the Officers' Reserve Corps, was called into the service. Although his commission was in the Chemical Warfare Service, some of the time was spent on temporary duty with the Quartermaster Corps doing development work on foods for army rations at the Massachusetts Institute of Technology. Reverting to the C. W. S., he saw overseas service in the European Theatre.

Mr. Mitchell returned to Walter Baker in January, 1946. He is presently Research Chemist; as such, he supervises the basic research and development work on chocolate products and processing.

Mr. Mitchell is a graduate of the Massachusetts Institute of Technology and is a member of the American Chemical Society, the Institute of Food Technologists and the American Association of Candy Technologists.

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The Chocolate Industry

I The Chocolate Industry

One of the most important characteristics that everyone looks for in the food he eats is flavor, perhaps even before any other property is considered. Some flavoring substances are produced for this property alone, but the Chocolate Industry processes a product noted not only as one of the most popular flavors, but also as a valuable food item. Chocolate and its counterpart, cocoa, are prime considerations for flavoring ice cream, milk, cakes and puddings. When sweetened with sugar they form our most important confections. Chocolate has long been recognized for its food value and is found in most emergency rations.

From the tropical regions of South and Central America and Africa come the cocoa beans of commerce noted for their pleasant, aromatic flavor and rich brown color. Proper blending and processing by the people in the chocolate business result in products enjoyed by everyone. People engaged in the occupations of this industry are trained and develop the necessary skills in order that they may produce the best possible product.

A. Origin and Early Development

Many industries, in their historical background, point to a primitive start and can trace their development from the days of the Egyptians or some equally ancient civilization of the Old World. The chocolate industry, however, found its birth in the New World, and its history cannot be traced much farther back than the accounts of the early explorers who followed Columbus. Although it had an early commercial development in Europe, the industry's birthright is truly American.

When the Spaniards under Cortez invaded Mexico in 1519, they found chocolate in common use. The seeds from which chocolate is made were used not only as an article of food, but also as a medium of exchange. According to accounts, Pizarro, another Spanish explorer, mentioned seeing cacao trees in bloom as he sailed along the coast of South America on his way to the conquest of Peru.

Before becoming too deeply involved in the subject, it would be well to acquaint the reader with the names or terms associated with chocolate. "Theobroma Cacao" is the botanical name of the plant on which the bean used for producing chocolate is grown. The first or generic word means "food of the gods." Linnaeus, the great Swedish naturalist who christened the plant, is said to have selected this name because in Mexican mythology chocolate was the favorite drink of the gods in Paradise. Cocoa, another form of chocolate, is believed to be a shortening of the pronunciation of the word cacao. Chocolate, although spelled in many different ways, is found to have much the same pronunciation in every language. The Mexicans called the drink which they made "chocolatl." "Atl," the suffix, is common in Mexican words and means water. The translation of the first part

of the word is not clear, but an early French writer interpreted it as signifying the noise made by the churn when the drink was prepared.

In general the word cacao is applied as the descriptive term for the tree and fruit until the beans have been roasted. However, one frequently will find cacao and cocoa used interchangeably. Chocolate is always the product of the roasted and ground cacao bean with or without sugar, milk solids or other flavoring substances added. Unsweetened or unflavored chocolate is generally known in the industry as chocolate liquor.

According to the explorers the Mexicans ground the roasted, almond-shaped beans from the chocolate plant with maize and certain flavoring materials to form a paste. The resulting paste was mixed with water and beaten to a frothy mixture which was served as a beverage known as "chocolatl." It is doubtful that the material was very sweet, as sugar was not known in America at this time.

Prescott, in his book "Conquest of Mexico," points out that chocolate was of importance to the people of Mexico as a luxurious beverage. In one instance he states, "the emperor (Montezuma) took no other beverage than the chocolatl, a potation of chocolate, flavored with vanilla and other spices, and so prepared as to be reduced to a froth of the consistency of honey which gradually dissolved in the mouth. This beverage, if so it could be called, was served in golden goblets with spoons of the same metal or of tortoise shell finely wrought. The emperor was exceedingly fond of it, to judge from the quantity — no less than fifty jars or pitchers being prepared for his own daily consumption. Two thousand more were allowed for that of his household."

Chocolate was first introduced in Europe in 1528 when Cortez returned to Spain from his expedition. It was here that the product received its first commercial development, as the delicacy met with great favor in the court of Charles V of Spain. The Mexican beverage of ground cocoa beans, maize and spices was not as well received, however, as the Spanish adaptation which consisted of adding sugar and serving as a hot beverage. Thus the Spaniards with their innovation from the New World were the first Europeans to manufacture chocolate in quantity, making their beverage thick like a porridge and pungent with spices. Even today the beverage which the Spanish consume is much the same as that of the sixteenth century.

The Spanish attempted to keep a secret of their new discovery and were successful for nearly a hundred years. However, it finally spread through the medium of monks to France and Germany and from those countries all over the continent of Europe. Its first introduction into England was by a Frenchman who opened a Chocolate House. In the "Public Advertiser" of June 16, 1657, was the notice "in Bishopgate Street, in Queen's Head Alley, at a Frenchman's house, is an excellent West India drink, called chocolate, to be sold where you may have it ready at anytime; and also unmade at reasonable rates." Soon many such houses sprang up and chocolate became a very popular as well as a fashionable drink.

The beverage, cocoa, which is common today is not the same as chocolate of the early days. In 1828 in Holland a man named Van Houten, who headed a company which today still bears his name, developed a process for removing part of the fat naturally present in chocolate. The remaining material was ground to a powder and called "cocoa." This material would mix more readily with water and milk because of its lower fat content, and met with great favor.

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Manufacturing plants for the production of chocolate were erected in England in 1728, in Germany in 1756, and in France in 1760. In the New World, where chocolate originated, commercial manufacturing was first started in 1765.

On the Dorchester bank of the Neponset River, about ten miles from Boston, Massachusetts, at a point known as Milton Lower Mills, the first cocoa beans were commercially ground in America. John Hannon, a penniless Irish immigrant and chocolate-maker by trade, wandered into Dorchester where he was befriended by Dr. James Baker. With the financial assistance of Dr. Baker, Hannon set up business in the corner of a new grist mill on the river, and on March 8, 1765, the first cocoa beans were ground. The beans were brought to the port of Boston by the merchants who went to the West Indies and South America.

The business flourished; but, in 1779, Hannon having been lost at sea, Dr. Baker bought the outstanding interest in the mill and took over operations himself. In 1780 he produced the first chocolate branded "Baker's," the forerunner of millions of pounds of chocolate similarly branded, for this small beginning led to the large Walter Baker chocolate plant of today. Although Dr. James Baker was the founder, it was not until his grandson Walter Baker took over the industry that it came to be known by its present name.

A location close to Boston was a logical place for the establishment of a chocolate mill for several reasons. There was considerable trade between the New Englanders and the Caribbean area, for the former had manufactured goods to trade for the sugar, rum, spices and cocoa beans of the latter. Water power had been developed considerably in this locality and could be used for turning the necessary machinery. In those days chocolate making was strictly a seasonal industry as it was dependent on cool weather for solidifying the molten chocolate. Therefore, New England, with its short warm season, was the best part of the country developed at that time in which to start operations.

It is interesting to note that the first advertisement of the manufacture and sale of chocolate in this country was in the Essex, Massachusetts, "Gazette" of June 18, 1771, as follows:

"AMOS TRASK

At his house a little below the Bell-Tavern
DANVERS

Makes and sells CHOCOLATE, which he
will warrant to be good, and takes Cocoa to
grind. Those who may please to favour him
with their Custom may depend upon being
well served, and at a very cheap rate."

From these humble beginnings the industry has grown rapidly. Steam engines and finally electricity replaced water power for operating machinery. The greatest advent, however, was the introduction of commercial refrigeration. No longer was the industry limited as to geographical location for the longest spell of cool weather; neither was it limited to operation only during the cool season of the year. Today the operation of chocolate plants is carried on by the most modern, progressive, manufacturing methods known.

AMERICAN INDUSTRIES SERIES

To show the magnitude of the chocolate business throughout the world, both as to production of cocoa beans and utilization by industry, the following statistics are quoted. It should be realized that some of the countries' imports do not necessarily indicate consumption, as part of the finished product may go to export. All figures quoted are in metric tons (2,204 pounds) for the 12-month period ending September 30, 1937.

EXPORTS

Gold Coast	304,816	Nigeria	103,328
San Thome	8,238	Cameroon	27,885
Ivory Coast	51,512	Brazil	107,641
Ecuador	19,517	Trinidad	12,790
Venezuela	15,000	Dominican Rep.	19,211
Togo	8,418	Grenada	3,573
Ceylon	3,907	Other Countries	34,155
Total		719,991	

IMPORTS

United States	311,908	Germany	71,381
Great Britain	99,449	Netherlands	54,746
France	41,056	Canada	16,886
Czechoslovakia	12,043	Belgium	9,020
Switzerland	7,222	Russia	7,882
Scandinavia	13,557	Austria	6,083
Poland	6,534	Others	62,224
Total		719,991	

Figures are quoted for the year ending September 30, 1937, since this is the last full crop year prior to the start of World War II. Cocoa bean statistics are figured on the basis of crop years which start October 1 and end September 30.

During the war years the major portion of shipping was required for the transportation of war material and little was available to haul cocoa beans. Because of this and the use of native labor for other pursuits, the cocoa plantations were not well tended. Diseases and insect attack of the cacao trees were common prior to the war, but with the neglect of the plantations, they took a stronger hold. Then at the end of the war when demand again rose, it was found that there was a definite shortage of cocoa beans. As a result of this shortage and the world-wide demand, prices of all chocolate products rose markedly until about the end of 1948 when they receded to a lower level. During and after the war until 1949 all cacao production came under the allocation of the International Emergency Food Committee. Then when the production became sufficient, allocation was no longer required.

Below are shown the provisional allocations of world exportable surpluses of cocoa beans in long tons (2,240 pounds) from the major producing areas of the world. These figures are for the crop year ending September 30, 1949, as developed

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by the International Emergency Food Committee. The allocations to the major consuming countries are shown from the same source. It is realized that these figures are not wholly accurate but will give an indication of the distribution in comparison to pre-war figures. It has been found that post-war cocoa statistics have not been reported as well as in pre-war years and are difficult to locate.

EXPORTS

Belgian Africa	1,450	French West Africa	78,000
Brazil	120,490	Other Latin America	75,680
British West Indies	10,810	Spanish Guinea	14,000
British West Africa	387,790	Portuguese Africa	8,700
Ceylon	2,000	Other Countries	4,750
Total		703,670	

IMPORTS

United States	287,720	Germany (Bizonia)	24,500
United Kingdom	128,150	Netherlands	38,800
France & Fr. No. Africa	48,300	Canada	22,000
Czechoslovakia	10,250	Belgium	17,250
Switzerland	12,500	Russia	18,000
Scandinavia	13,350	Austria	3,000
Poland	2,860	Others	76,990
Total		703,670	

It will be noticed that the figures for 1949 differ somewhat from those of 1937. As mentioned above, reduced production in some areas is due to lack of care during the war years. However, rehabilitation and new plantings will gradually increase production again. Changes in their economies following the war may account for the differences in the amounts imported by the various countries.

B. Size of the Chocolate Industry in the United States

The production of chocolate and its related products is carried on by companies who sell only these items as well as those who manufacture chocolate for their own use in their production of confectionery. In the statistics quoted below the chocolate industry is taken as those establishments primarily engaged in manufacturing chocolate, cocoa powder, cocoa butter, solid chocolate bars and chocolate coatings. Companies primarily manufacturing chocolate and cocoa preparations or confectionery from purchased chocolate or cocoa are not included.

The most suitable source of such information is the bi-yearly publication, "Census of Manufacturers," by the U. S. Department of Commerce. The latest data is for the year 1947 which shows a total of 31 establishments. Below is tabulated the information available as to their location, size and average number of employees. Such information is not available for individual companies.

AMERICAN INDUSTRIES SERIES

<i>Location</i>	<i>Number of Companies (Average for year)</i>	<i>Number of Employees</i>	<i>Wages and Salaries</i>
Total	31	9605	\$27,480,000
Northeast	22	8948	24,963,000
Massachusetts	3	1160	
New Jersey	4	299	
New York	8	2680	8,249,000
Pennsylvania	7	4809	12,625,000
Other divisions	9	657	2,517,000
Illinois	3	219	
Wisconsin	2		
California	3	183	650,000
Washington	1		

The above information represents the last published statistics which are available. It is possible that the number of companies may change slightly from year to year. In 1949 it was estimated that there were 39 companies processing cocoa beans for their use or in manufacturing chocolate and its related products for sale. Detailed figures were not available, however, at this writing.

II **Cultivation of Cacao and Manufacture of Chocolate**

The production of fine-flavored, finished chocolate is very dependent on the processing which the cocoa beans receive in the tropics where they are grown, as well as the treatment which they receive in the manufacturer's plant in the temperate zone. Therefore, before delving into the manufacturing operations of the factories in this country, let us see what happens to the cocoa bean from the time it starts to grow.

A. **Cultivation and Processing in the Tropics**

Although cocoa beans were first found by the European explorers in America, they are now cultivated in many parts of the world. However, because of their nature, they require a warm, humid climate which has a mean temperature of about 80°F. and 60-100 inches of annual rainfall. For that reason they are found in a belt around the world approximately 20° north and south of the equator. The most significant crops of cocoa beans are found in Central America, some of the islands of the Caribbean, the northern countries of South America, and the west coast of Africa, Ceylon, Java and Samoa.

The cocoa beans, which have a thin, brown skin and are the approximate size and shape of an almond, grow inside a thick-walled, orange-brown pod about the size and shape of a cucumber. Between 25 and 40 beans are contained in a thick, white, gummy material inside the pod. Unlike our native fruit, such as the apple and pear, the pods grow on the trunk or heavy branches of the tree rather than out on the ends of the small limbs.

The cacao trees grow to a height of 30-40 feet and are cultivated in large plantations. Like coffee beans, cocoa beans must be grown in the shade; there-

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fore, the trees are always planted under sheltering foliage for protection from the hot sun. The trees may be started from seed or propagated from cuttings taken from other cacao trees. They first are rooted in small pots made of large bamboo shoots and are then transplanted. It takes from five to seven years before a tree will begin to bear fruit. Again, unlike our native fruit trees, cacao trees have two crops of fruit a year; consequently, it is not uncommon for the tree to be in blossom at the same time it is bearing fruit.



Cracker and fanner operator, inspecting nibs from the fanner.

When the color of the pods on the trees has turned from green to a red-orange or a yellow-brown, they are considered ripe and ready for harvesting. Native laborers, using long poles to the end of which has been attached a knife with a hook-shaped blade, cut the short stem holding the pod to the tree. The pods are gathered up and taken to a central location where they are opened.

The skin of the pods is thick and tough, so it is necessary to slash them several times with a sharp machete in order to break them open. The beans and the adhering mucilaginous material or pulp are scooped out into large vats where they are allowed to "sweat" or ferment. The beans, when first removed from the pod, are a faint pinkish-white; after a short exposure to the air they soon begin to turn brown. The pulp clings to the beans very tenaciously, but it

contains a small percentage of sugar and therefore will ferment, forming alcohol. Thus, when the beans and pulp are put into the "sweat boxes," they are kept warm at first to start the fermentation which is incited by natural-occurring bacteria. The alcohol which forms is allowed to drain away. This operation lasts from five to eight days, depending on the judgment of the plantation owner as to when the desired changes have taken place.

In the fermentation process several desirable changes occur in the cocoa bean, most important of these being the color and flavor development. The color progresses from a pinkish purple to a deep brown in the case of a fully fermented bean, although these color changes will vary with different types of beans. Likewise, the flavor develops in aromatic and mellow chocolate characteristics and loses its original harsh astringency and acidity. Secondly, the gummy nature of the pulp is destroyed; it is more readily removed and the beans can be dried more efficiently and will not stick together. Because of the heat developed during the fermentation (110-120°F.), the germ in the bean is killed, and there is no danger of the beans sprouting at some later time when they are in storage. Before the beans are fermented, they are plump and the skins are soft, but the process causes the skins to shrink tightly to the kernel and toughen, thus guarding against insect infestation.

After fermentation the beans are cleaned of adhering pulp and dried to a moisture content of about 6 to 7%. This moisture is low enough so that there is no danger of the beans becoming mouldy under normal storage conditions. The drying is accomplished by one of two methods. The beans may be spread on platforms which are moved into the sun, then the beans are turned and mixed by hand, or they may be dried artificially by rotating in large heated drums. The procedure depends on the quantity of beans to be handled and the progressiveness of the producer. In the case of sun drying, several days are required, while the latter process may be completed in a matter of hours.

When the beans are sufficiently dry they are put into burlap bags (140-200 lbs. per bag) and then are ready for shipment to the chocolate-producing countries. Since they generally are produced in the interior, they must be transported to a port and await the arrival of a ship.

It is interesting to note the method by which the different commercial varieties of cocoa beans are named. Some are named for the island or country where they are grown, e.g., Panama, Ceylon, Samoa, Venezuela; but others are named for the port from which they are shipped, e.g., Accra, Lagos, Caracas and Para.

Above has been described the fermentation, cleaning and drying processes. This is the curing technique generally followed for most cocoa beans. However, there are a few low-grade varieties which are not fermented but merely dried and bagged for shipment. There are both advantages and disadvantages to this procedure. On the side of advantages there is less labor involved in the processing, the beans can be gotten to market a week or two earlier, and, of course, the over-all cost of producing the beans is reduced. The major disadvantage to this method is that the flavor and color developed in general are not as good as that of a fermented bean. However, the question arises as to whether or not these beans, after additional treatment, would be worth the increased production cost.

In a preceding paragraph the names of several varieties of cocoa beans were listed. Although they all belong to the same family, their flavor and color char-

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acteristics vary markedly. People describe a color as "chocolate-brown" but in the industry that color covers quite a latitude when shades of red, yellow and violet go into making the brown. The flavor of the bean may vary from a light, aromatic type in one variety to a harsh, astringent flavor in a different variety of beans. All of these variations are needed in making a fine-flavored chocolate. Some varieties are very plentiful while others are relatively scarce. The above-mentioned factors enter into setting the prices of the various kinds of cocoa beans in world commerce.

B. Manufacture of Chocolate and Cocoa

When the cocoa beans arrive in this country they are sold through brokers to the manufacturers of chocolate and cocoa. After being landed at shipside, the bags of beans are transported to the manufacturer's plant or storage space. Since



General labor unloading cocoa beans and emptying into conveyor to silo storage.

the beans are produced seasonally, it is necessary that he maintain an inventory of raw beans in order to have continuous production throughout the year.

The beans may be stored in the bags in which they arrive or they may be removed from the bags and stored in bulk in silos as is grain. In either case they

must be kept dry so that mould will not develop; yet the atmosphere should not be artificially dry, or the beans themselves will dry out, become brittle and break open, making them difficult to handle and open to insect infestation.

1. Cocoa Bean Processing

The first step in the processing of cocoa beans is cleaning, to separate any foreign material which may have been scooped up with them when they were bagged on the plantation. The beans are screened and winnowed to remove sticks, straw, dirt, etc.; then they are passed over a powerful magnet to remove any metal. The beans must be clean because they go into a product for human consumption; therefore, any foreign material must be removed to insure a pure product.

Next comes one of the most important steps in the manufacture of chocolate: roasting. The men tending the roasters have a great deal of responsibility in the finished product, for on their judgment of flavor in the roasting of the cocoa beans depends in part the taste of the final product, whether it be cooking chocolate, cocoa, sweet coating chocolate, or a candy bar. In order to roast the cocoa beans, a temperature of around 300°F. is required. The beans are put into large, revolving, steel drums heated by steam or gas and allowed to remain until the flavor is judged to be that required for the use to which they are to be put. Then the beans must be immediately cooled with large quantities of cool air, otherwise the beans would "auto-roast." That is, cocoa beans are poor conductors of heat; if the hot beans are kept in a mass, they would continue to roast themselves from their retained heat, resulting in an over-roast and possibly burning.

Four important results are accomplished in the roasting. Most important is the volatilization of harsh, astringent and acidic materials and development of fine aromatic or base flavors, depending on the type of bean being roasted. This is a further flavor development in addition to that achieved in the fermentation process in the tropics. The color is also improved by roasting, and its depth can be controlled to a certain degree by the amount of roasting allowed. The shell is loosened and, as does the interior of the bean, becomes brittle, so that the two may be separated readily in the next operation. Finally the moisture content is reduced from about 6% to less than 1.0%, which allows for easier grinding in a future part of the processing.

The cooled beans from the roasters are next fed through a machine called a Cracker and Fanner. The cracker consists of a pair of rolls with coarse, irregularly-spaced, intermeshing teeth rotating towards each other. The rolls are close enough so that the beans are broken when they pass through. The fanner, another portion of the same machine, is a winnowing machine whereby the shells and dust are blown free and collected separately from the broken kernel. The latter is naturally formed into many small segments, all fitting together much like a jig-saw puzzle. These are broken apart in the cracking operation and are known as "nibs."

In producing any chocolate product, a single variety of beans is seldom used. Generally two, three, four or perhaps even more different kinds of beans are blended to produce a combined flavor with certain particular characteristics. Therefore, following the fanner is a blending operation whereby nibs of different

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kinds are fed from hoppers in the proportion desired for the chocolate being produced. The nibs then feed to the mills where they are ground.

Cocoa beans, or the nibs, contain about 53% fat which melts just below body temperature; therefore, when the nibs are ground at above body temperature they will form a liquid in their own fat. This resulting liquid is known as "chocolate liquor" and, when solidified, is the same as ordinary baking chocolate.



Pilot plant operator preparing a batch of chocolate in the pilot plant melanger.

The mills in which the nibs are ground consist of one stone rotating on a fixed stone in a horizontal plane. The nibs are fed from a hopper through the center of the top rotating stone. Then they are caught between the stones, which are about three feet in diameter and are ground into a homogeneous mass as mentioned above. Underneath the stones are steam coils to keep the mills hot so the fat will melt, although generally the heat from the friction of grinding is sufficient. The pairs of stones are usually operated doubly or in triplicate, depending on the fineness of grind desired. The rate at which the nibs are allowed to run into the mill will also determine the fineness of the resulting liquor. Fineness of grind, of course, is the primary requisite of the grinding; however, it should be noted that the flavor of the chocolate is aided in that the heat and abrasion cause a release and volatilization of some of the harsh, acrid compounds contained in the nib.

The resulting liquor drains from the mills to storage tanks where it is available for different uses. It may go for making sweet chocolate, cocoa, or be processed in its present form without the addition or subtraction of any ingredient and be sold as bitter chocolate. If this is the case, it is cooled as will be described in the processing of sweet chocolate, packaged and shipped. Such a product is sold to the retail trade as cooking chocolate or is sold in bulk as chocolate liquor to bakeries, manufacturers of chocolate syrups, etc.

2. Cocoa Powder Production

Cocoa or cocoa powder is chocolate liquor from which a portion of the fat or cocoa butter, as it is called, has been removed. This form of chocolate is preferable where a large percentage of fat is not desirable, as in a beverage. With the reduced amount of fat it is more readily dispersible in milk or water. The fat content of cocoa may be anywhere in the range from 10% to about 25%, the content being one of the factors determining its price. Federal regulation governs classification of cocoa powder as to labeling according to fat content, such as low fat and breakfast cocoas. The latter, for example, shall contain not less than 22% fat.

In manufacturing cocoa, chocolate liquor at 200-240°F. is pumped into a hydraulic press where it is placed under pressure. The cocoa butter separates, squeezes out through fine openings and empties into a storage tank. This recovered fat may be used in the manufacture of sweet chocolate or it may be cooled, poured into molds, solidified, packaged and sold to manufacturers of pharmaceuticals, cosmetics or confectioneries. The hydraulic presses will hold 300 to 1,200 pounds of chocolate liquor and operate on a 20 to 45 minute cycle, depending on the desired fat content of the finished material and the size of the press.

When the pressing is complete, the ram is released and the press opened, ejecting the cake. Since the material becomes extremely hard on cooling, it is put through a breaker while still hot to reduce it to small pieces for feeding to a pulverizer. On cooling it is fed to a hammer mill for pulverization. The resulting powder is next cooled at 65 to 70°F. and kept in this temperature range during the balance of the processing. By proper cooling, that is, a slow, even cooling, the fat is solidified in such a manner that the cocoa will not lump in the future on storage and the color will remain bright. Both of these factors are important for salability.

After cooling, the powder is sifted by one of two methods. It may be put through an air classification system where it is conveyed by air and separates by difference in density, or it may be sifted mechanically on a fine silk screen. It should be realized that the individual particle size is very small. In an average cocoa essentially 100% of it will pass through a screen having 100 openings per inch. The residue or tailings are reground.

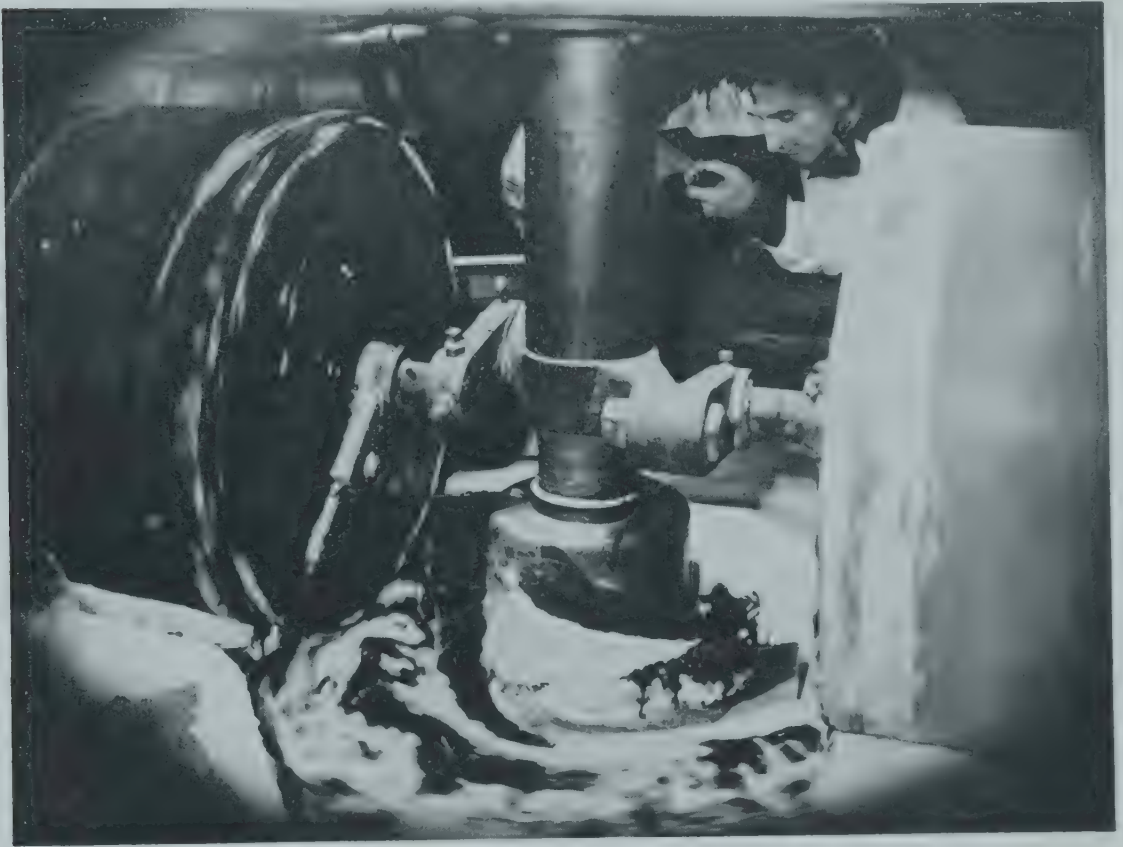
The powder is now ready for packing. There are several types of containers used. It may be put into small cans for retail sale or be packed into 50 or 100 pound paper bags or barrels for sale in bulk lots.

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3. Sweet Chocolate Production

Another important use of chocolate liquor is in the manufacture of sweet chocolate. This product is sold in several forms: in bulk lots in 10-pound slabs to confectioners for coating centers and to bakers for coating cookies, in small candy bars for direct retail sale or in special form such as small pellets called chocolate chips. In any event, the processing is the same up to the point where the chocolate is moulded, and there it differs only in the shape and size of moulds.

Sweet chocolate is a homogeneous mixture of chocolate liquor, cocoa butter, sugar, flavoring material and dried milk in the case of milk chocolate. The cocoa butter used in sweet chocolate is that obtained in the manufacture of cocoa. It is necessary that it be added because the fat present in the amount of chocolate



A mixer (sweet chocolate processing) adding chocolate liquor to other ingredients in a melanger for making sweet chocolate.

liquor used is not sufficient to make the mass readily workable or fluid in view of the dry solids that are added.

The ingredients mentioned in the previous paragraph are mixed in a machine which has good agitation so that a uniform mass is obtained. One such machine which is quite common is called a melangeur. It consists of a dished stone bedplate rotating under a pair of heavy stone rollers. By a system of baffles

the material is guided under the rollers as the bedplate revolves so that kneading action is obtained, thus blending the ingredients more thoroughly. A steam coil is underneath the bedplate so that the material may be kept hot to keep it from solidifying.

After the ingredients are mixed thoroughly it is necessary to grind the mixture to give it a fine, smooth texture. This is accomplished on five-roll refiners, a machine similar to that used for fine grinding in other industries. It consists of a bank of five stone or steel rolls mounted vertically, the distances between which can be finely adjusted. The operating principle is as follows: when the rolls are run at increasing speed from the bottom to the top the material will pass from the slower-moving roll to the faster roll when they come in contact. Also, when the material passes between the rolls a shearing action occurs which crushes the coarse particles. The speed of the rolls increases from about 20 R.P.M. at the bottom to about 100 R.P.M. at the top and gives a production rate of 1,200 to 1,500 pounds per hour, depending on the degree of fineness desired and the type of chocolate. The product is scraped off the top roll in the form of a dry, flaky substance. One of the major advantages of this type of machine is that a progressive four-stage reduction of particle size may be obtained on one unit rather than a one-step reduction.

The following operation is called emulsification. The dry material from the grinders is fed to a large, horizontal, jacketed tank having vigorous agitation. More cocoa butter is added and the mixture rapidly stirred to break down the dry material and form a uniform mixture with the cocoa butter. By the addition of heat, undesirable volatile materials from the chocolate liquor may be driven off during this agitation and a blending of flavors is obtained.

An additional operation to emulsification, which is used on more expensive grades of chocolate, is called conching. Here the chocolate is put into heated stone or steel pockets in which a roller is run back and forth for long periods of time — as much as 90 hours. The results obtained are similar to those from emulsification, but it is possible to get more blending of flavors and to develop a finer texture.

The chocolate has now had all of its processing and is run into jacketed holding tanks ready for depositing. In the tanks the chocolate, while continually stirring, is cooled to within 10 to 15 degrees of its solidification temperature. Cocoa butter is added, if necessary, to bring the chocolate to the proper viscosity.

Tempering is the term applied to the proper cooling of chocolate. That is, it must be slowly cooled without too sudden a shock, otherwise, the crystallization of the fat is not stable, and a fat bloom will appear on the product later on, spoiling its gloss or appearance. This subject, however, has too great a scope to discuss in detail here. In production the chocolate is run through jacketed, water-cooled columns reducing its temperature to about 86°F.; it is then fed into a depositor which releases a measured amount of chocolate into each mould on an endless belt as it passes underneath. The moulds pass into a cooling tunnel in which cold air (40-60°F.) is constantly circulated. While the moulds are in the cooling tunnel the chocolate cools, solidifies and contracts slightly; when the moulds emerge on the opposite end of the tunnel, the solidified chocolate will readily drop out of them when they are inverted. The bars of chocolate are wrapped, packaged and sent to the air-conditioned warehouse to await shipment.

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4. Dutch Process Liquor and Cocoa Production

One other process which requires mention is the manufacture of Dutch Process Liquor, and from it Dutch Process Cocoa. This name is attributed to chocolate products which in their processing have been treated with alkali.

Federal regulation limits the types of alkalies which may be used to the carbonates, bicarbonates and hydroxides of sodium, potassium and ammonia and magnesium carbonate. Also the quantity which may be used may vary up to 3% of the weight of the nibs or shelled beans by weight of potassium carbonate or its neutralizing equivalent.



Pilot plant operator cooling experimental batch of chocolate for moulding.

The action of the alkali is to produce a more mild flavor by neutralizing natural acidity of the cocoa beans, or, if the quantity is great enough, actually make an alkaline product. The color is increased in depth and becomes more red or brown. Different alkalies and different amounts with varying reacting times and temperatures will result in innumerable types of products.

The alkali is introduced in a water solution and may be brought into the process in one of several places. It may be sprayed on the beans prior to roasting, after which they follow the normal processing as previously described. Another method involves half-roasting the raw beans. Then they are cracked and fanned and the alkali sprayed on the nibs. After allowing for reaction the nibs are again

roasted and then processed in the normal manner. One other method is to spray the alkali solution into chocolate liquor which is being agitated vigorously. Then heat must be applied to drive off the moisture which was used as a carrier for the alkali. These three processes are known as bean dutching, nib dutching and liquor dutching respectively.

After any of the above-described treatments the resulting material follows normal processing as described earlier. If the final product, whether it be cocoa, sweet chocolate or liquor, contains dutch-processed liquor, it must be so indicated on the label.

5. Milk Processing

Fluid milk cannot be used directly in the manufacture of milk chocolate because of its large percentage of water, the latter being immiscible with the fat of chocolate. Therefore, practically all of the water in the milk must be removed by evaporation before use of the latter in chocolate. Many concerns are devoted entirely to the production of dried milk, and they supply it to chocolate manufacturers. However, in the drying of milk, by proper control of drying conditions, it is possible to produce different types of flavors in the finished product which blend advantageously with chocolate. For this reason many chocolate manufacturers prefer to dry their own milk or at least a portion of it.

6. Supplementary Departments

The manufacture of chocolate products is the primary function of the plant, and the majority of the employees are directly involved in its processing. However, just as infantry troops require supporting forces such as artillery, engineers, etc., in combat, so additional employees are required in the chocolate industry, even though they are only indirectly responsible for the product. Since the functions of the departments to which these employees belong are, in general, common to many industries, a lengthy description will not be made of them except in a few instances. Details of the individual jobs will be found in the section Employment Opportunities.

(a) Engineering Department

In any plant with a large quantity of mechanical equipment to be maintained, utilities to be furnished and improvements in mechanical operation to be planned and executed, an Engineering Department is necessary.

Steam is required for heating and processing equipment and, most important, for keeping storage tanks of liquid chocolate hot twenty-four hours a day. Without quantities of continuous heat the plant would have to shut down. Just as some areas must be kept hot, others, such as the warehouses of finished goods, must be kept cold; otherwise, the goods might be damaged or destroyed beyond salability.

There must be a well-equipped shop for maintenance, repairs and installation of new equipment. A staff of machinists, mechanics, millwrights, pipe fitters, tinsmiths, electricians, welders, blacksmiths, carpenters and painters is required. All must be skilled men and have available the tools of their trade.

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New processes or changes in existing processes require the talents of construction and mechanical engineers. In order to plan such changes or additions, drawings must be made. Thus draftsmen are also needed.

(b) Laboratory and Control Research

In the food industry an efficient laboratory is a must for checking the quality, both of the raw materials it purchases and the products it manufactures. Chocolate and its related products, particularly in the case of bulk sales, are sold on the basis of certain qualities or standards. In order to insure that these standards are met, finished goods are sampled and analyzed.

Each batch of cocoa and chocolate is checked before it leaves the plant, and a record is kept of the results. Cocoa is sold on the basis of fat content, fineness,



A control technician running an analysis on chocolate for determining the fat content.

color and flavor. Sweet chocolate is standardized for viscosity, fineness, color, flavor and an analysis is also made for fat content. All of the above-mentioned requirements must meet the established specifications before the goods are passed for shipment.

Raw materials entering the plant, such as cocoa beans, sugar, milk and other ingredients, must also be checked by the laboratory. In addition, numerous special analyses are required from time to time. All of this adds up to a qualified staff of chemists, analysts and technicians.

In addition to the control section are sections for development of new coatings, new cocoas and for research projects. The titles of these laboratory sections are self-explanatory; therefore, a long description will not be entered into here. However, a description of the jobs pertaining to them will be found under Employment Opportunities.

(c) Shipping, Receiving and Warehousing

Much consideration must be given to the handling and storage of perishable raw materials and products. When raw materials are coming in, plans must be laid as to where they are to be stored, keeping in mind what, if any, special temperature and humidity conditions are required and how readily accessible the materials must be. That is, are they to be used in a week or a month and in what department are they needed? The receiving section must have its plans all made, ready to act so that transportation facilities will not be delayed unnecessarily.

Warehousing must be planned efficiently in order that space is not wasted needlessly. Chocolate and cocoa should be stored at 65 to 70°F. for best protection. The storage should be planned so that rapidly-moving goods are nearest the loading platforms. Sufficient space should be allowed for mechanical stacking machines, yet unnecessarily wide aisles should not be left for inventory purposes.

Shipment of finished goods necessitates careful planning, also. If the shipment is made during the warm months or is going to a warm climate, the goods must be put into insulated transportation. Close liaison must be kept with the Traffic Manager so that the proper type of transportation is requested.

(d) Purchasing Department

In a large plant there are a thousand and one items to be bought. Raw materials for manufacturing into finished goods, such as cocoa beans, sugar, milk and flavors, are constant requirements. The market must be watched in order that purchases may be made at the best price and that quality merchandise is secured. Also, the purchase must be geared to requirements and storage space.

An intelligent purchasing staff is needed because of the diversity of items required, particularly when it comes to buying new equipment, maintenance parts and odd items. Of course, the department requiring the purchase can be of some assistance in the purchase of uncommon things.

(e) Sales Department

After all the other people have done their jobs of securing the materials and making the finished product, it remains for the Sales Department to find a market. The reverse is also true: if the salesmen could not sell the product, then the others would have no need for making it.

The Sales Department must keep in touch with the trade which is going to use the finished goods, make the contracts and establish what items are to be produced. In the case of bulk sales the market is generally found before the goods are produced. Of course, items for retail sale, like chocolate bars and small containers of cocoa, are produced at a rate commensurate with expected sales. Frequently, new items for manufacture are introduced by the Sales Department

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based on the existing market, sales which might be expected, or for competition with similar products.

Advertising is an important section of the department. It is impossible for salesmen or brokers to reach everyone, but, by attractive and informative advertisements, a greater portion of the public is reached. Skillful illustrations and copy aid a great deal in bringing a product to the public's attention. All of the advertising work may be done in the department, or only the rough ideas may be started here, and it is left to an advertising agency to put them into final form.

Promotion schemes (e.g. samples and recipe books) are handled by the Advertising Section, as well as informative requests about the product, processing or company.

(f) Controller or Treasury Department

In a large concern where quantities of money are being handled, it is necessary for some group to keep track of the transactions. When it is desired to spend money for additions, equipment, etc., the question arises as to whether or not the company can afford it. When a selling price of a product is being established one must first know what the production costs are. For these reasons and many more a controller department is maintained.

Under the jurisdiction of the controller is a section for drawing up the budget and seeing that it is followed. Another section takes care of the orders and billing. They type the invoices for shipments. A Credit Manager is essential to check on accounts and determine where and how much credit should be allowed. A Cost Accounting Section, through surveys and studies, determines how much it costs to manufacture the various products, or whether or not an operation is profitable. The Paymaster Section is just what the name indicates; it takes care of making up the payrolls and the checks for all of the employees.

III Personal Qualifications

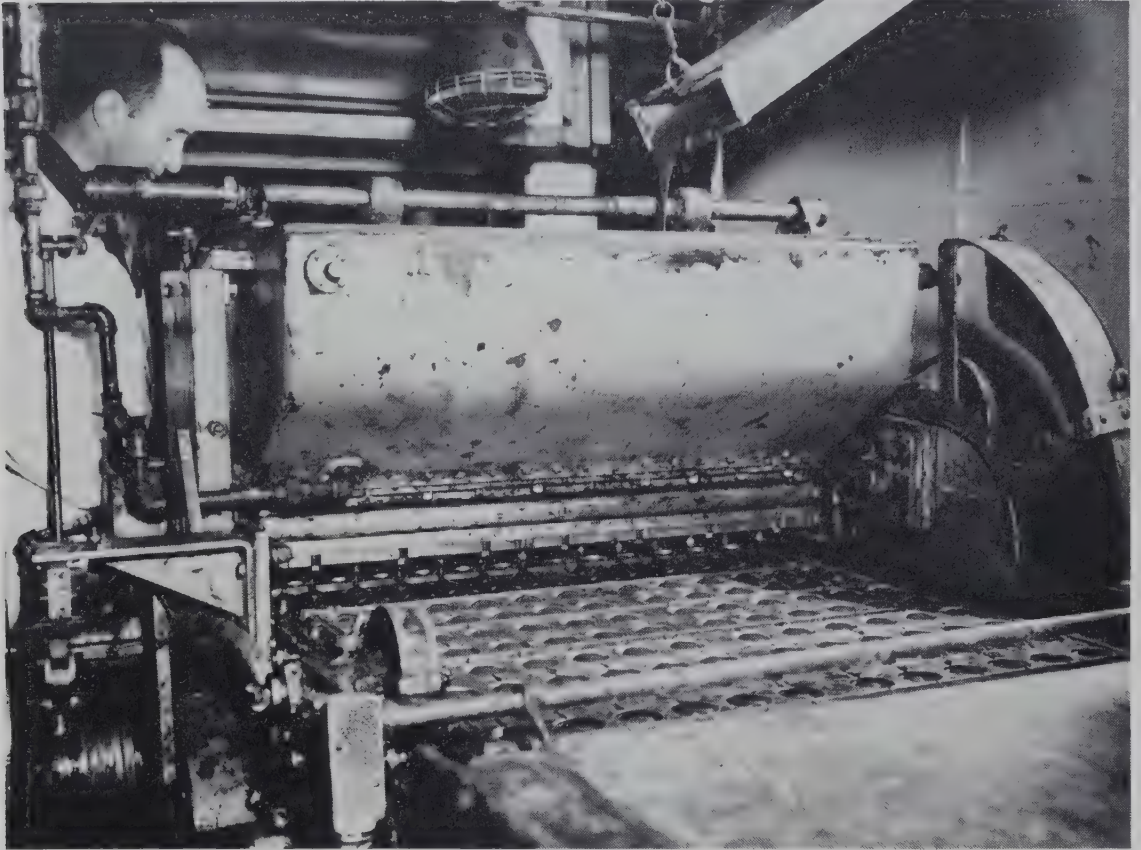
In an industry with as many different types of jobs and required skills as indicated by the description on the preceding pages, it is easy to understand why it would be difficult to lay down any generalized qualifications for the Chocolate Industry. As far as educational training and experience are concerned, those requirements vary and can be determined only by a study of the demands of the individual job. Otherwise, the qualities of an ambitious, clean-living, honest, cheerful, hard-working person are all that are needed in this industry, just as in any modern, progressive business.

There are the jobs which require only a strong back and grim determination. From this it is possible to continue all the way up the line through qualifications possessed by those who attended high schools, trade schools, accounting and business administration schools, secretarial schools and colleges. There is a place in the Chocolate Industry for people who have attended any of these places of learning.

Individual character is important in any occupation. A person must be industrious and ambitious or he is not an asset, and liabilities in employees are worthless. If he is not honest or trustworthy, it goes without saying that he is not desired by any employer. Ability to get along with fellow-employees is a

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valuable attribute in that it tends toward better cooperation and easier working conditions. Of course, it should be realized that this is an industry manufacturing products for human consumption; hence, cleanliness of person and workmanship are also very important.



Tempering and depositor operator controlling the operation of a chocolate depositor.

In other words, the three basic requirements might be stated as: education to fit the individual job, good character and an interest in the work. More detailed information as to the various jobs will be found in the following section.

IV Employment Opportunities

In a manufacturing enterprise as large as the Chocolate Industry it should be realized that there is a tremendous number of opportunities for employment. If all of them were to be described here, it would take a book several times this size; therefore, the brief descriptions have been limited to the most important ones of each department or section. For facility in understanding the part the particular job plays in the processing, the descriptions have been grouped in the same order and under the same heading as used in Section II.

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A general classification of the minimum educational requirements for each job is indicated. This does not mean that a person with less education could not hold such a job, as individual aptitudes vary markedly, but it is meant only as an indication. Also, a person with less training might qualify as an assistant and train on the job. Descriptions marked by "*" normally require college training, marked by "+" normally require technical school or business administration school training and those unmarked normally require high school or trade school training.

A. Production Department

***Production Manager.** The Production Manager is responsible for the production plans and policies of the company, installation of new processes and supervision of all production of the plant. Such a position requires a man experienced in engineering and the solution of production problems.

***Production Superintendent.** He is the assistant and right-hand man of the Production Manager and is directly concerned with production problems in the plant.

†Production Planner. He schedules the weekly output of the plant, thus it is necessary that he know the capacities of production units so that production requirements, as called for by the Sales Department, may be planned efficiently. By proper coordination goods are produced to meet contract deliveries.

1. Cocoa Bean Processing

Bean Cleaning and Furnishing. He tends the machines which clean raw beans, control the rate of feed, insure proper adjustment for efficient cleaning and is always on the alert for any abnormal conditions.

Bean Roaster. This is a most important job since the operator must develop skill in judging and controlling the degree of roast on beans. He starts and stops the roasters, makes adjustments as necessary for control, takes samples and keeps records of types and quantities of beans roasted.

Cracker and Fanner Operator. His responsibility is the proper operation of machines to accomplish the cracking of roasted beans and clean separation of shell from nibs.

Nib Blender. He controls nib blending machines to obtain the correct blend of nibs as required by formula, operates conveyors and keeps a daily record of nibs furnished.

Mill Operator. It is the Mill Operator's job to insure the proper feed rate of nibs to the mills and the adjustment of the latter for achieving the maximum production rate. Yet he must obtain correct fineness of grind, which he determines by a rapid method. On his efficiency depends the fineness of products made from the liquor.

Liquor Pumper. He pumps liquor to the using departments, plans tank space for storage pumping, operates pumps, meters and valves, takes laboratory control samples and keeps records on liquor distributed.

Dutch Treatment Operator. His job consists of preparing dutching solutions of alkalies, operating automatic weighing scales which feed the dutching tanks, maintaining proper temperature control of the process and inspecting the material in process.

2. Cocoa Powder Production

Pressman. Assisted by one or two men who are training on the job, he operates the hydraulic press, feed pumps and press cake conveyors. He is responsible that the liquor is pressed to the proper fat content, takes control samples and keeps a record of pressings.

Powder Plant Leader. The Powder Plant Leader checks equipment operation in the production of finished cocoa. Supervising various operators, he makes sure equipment is run efficiently and proper adjustments and temperatures are maintained, particularly on automatic equipment.

Powder Plant Feeder. He weighs and feeds the press cake to the pulverizers, blending it when necessary and adding flavors when called for.

Powder Plant Draw-Off Man. This operator draws off the finished powder and weighs it into bags or barrels, being responsible for correct weight. He sews the filled bags and heads the barrels and also takes laboratory control samples.

Packer (female). She tends the cocoa cannister filling machine, inspecting for proper filling, correct weight and satisfactory sealing of each can.

Powder Plant Pulverizer Operator. He makes the operation adjustments on the press cake pulverizers. In addition to the required fineness of grind, he must maintain an efficient production rate.

3. Sweet Chocolate Production

Mixer. He weighs and mixes the ingredients of sweet chocolate, adding flavors as called for and insuring that the ingredients are blended thoroughly before feeding to the grinders.

Refiner Operator. This job requires a skilled and efficient operator. Adjustments are made on the settings of the rolls for obtaining proper fineness and achieving a good production rate; on-the-spot fineness measurements are needed to insure that the grinder is functioning properly. Production records are kept. He also tends the emulsifiers, checks the time of mixing and the temperature of the chocolate, adds extra cocoa butter and empties the emulsifier when mixing is completed.

Standardizer. The Standardizer checks the viscosity, fineness and color of chocolate in the holding tank and, when necessary, adds extra cocoa butter to bring the chocolate to proper viscosity; additional liquor also may be called

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for. A viscosimeter is used for measuring viscosity, and a definite technique is needed. Since the final product depends on his measurements, this man should be efficient and trustworthy.

Conche Operator. He pumps chocolate to and from the conches, checks the temperature, takes samples and judges the flavor, although his analysis is not final.

Tempering and Depositing Operator. He adjusts the temperature on the holding tanks and tempering columns, operates the depositor, checks the weights of chocolate from the depositor, sets the belt speed through the cooling tunnel and makes sure proper temperatures are kept in the tunnel.

Packer. Generally several people share these jobs: operation of the automatic wrapping machine, making adjustments when necessary; packing of the wrapped cakes into cartons and operation of the sealing machine; or packing the cakes into burlap bags and sewing them. Laboratory control samples are taken and records kept.

Packer (female). She tends automatic machines for wrapping confectionery items and packs the wrapped goods into cartons.

The following four jobs are common to each of the separate departments; they are described below rather than under each of the departments previously mentioned.

†Foreman. A general foreman is responsible for all the operations and personnel in a department. He plans and schedules production of the department and keeps necessary records and reports. He is aided by an assistant foreman or supervisor.

Clerk (female). She keeps routine records of the production of the department and makes up and types the necessary reports and requisitions.

General Labor. Unskilled helpers are needed to fill in and work under close supervision; they are in a position to train for many jobs in a department.

Service Mechanic. A general mechanic is assigned to a department to take care of minor mechanical difficulties and the oiling and lubricating of equipment. Any heavy or difficult repair work is taken care of directly by shop labor.

4. Milk Processing

Mixer. He operates the pumps, valves and metering equipment for feeding milk and sugar to the evaporators and also keeps records of the material processed.

Evaporator. This job requires a skilled operator who is able to judge the product in the evaporator and maintain a very efficient control of temperatures and pressures in order to insure a quality product.

Drying Operator. He tends the equipment used to finish drying the product from the evaporator pan. He runs the dryer for a good production rate, taking proper care that the product is dried, yet realizing that the flavor must not be injured by excessive heat. He packs the material into drums for shipment to other departments and keeps records of finished material.

B. Supplementary Departments

1. Engineering Department

***Plant Engineer.** The Plant Engineer is responsible to the Production Manager for engineering design and layout of new processes, construction and installations, operation and supply of utilities and general maintenance of plant equipment. He must possess good general knowledge of and experience in engineering work.

***Project Engineer.** He plans and supervises new construction and the installation of new equipment. This type of work necessitates a practical man with much ingenuity as well as a wide engineering background.

***Development Engineer.** He is a technically trained engineer capable of designing new equipment and process methods. Naturally he must have a complete knowledge of chocolate and its processing.

†Draftsman. This job requires a moderate amount of training or experience in the design and layout of factory equipment and processes. Serving as a Junior Draftsman gives a man training in this type of work.

†Power Plant Engineer. A licensed engineer with either knowledge or experience runs the large steam boilers, either coal or oil fired. He must be capable of making or supervising repairs to the equipment.

†Refrigeration Engineer. A Refrigeration Engineer is on the job at all hours to care for the equipment providing refrigeration to storage and process areas.

†Service Engineer. A Service Engineer, usually a young man with a moderate amount of technical training, is employed for running tests on and adjusting plant equipment.

†Master Mechanic. In direct charge of the shop and shop personnel is the Master Mechanic, who plans and lays out work under the supervision of the Plant Engineer. His job demands general knowledge, experience and mechanical ability.

He has under his jurisdiction assistants who are in charge of sections employing mechanics, electricians, millwrights, pipe fitters, machinists, tinsmiths, carpenters, welders and blacksmiths. A description of these individual jobs will not be undertaken here since their type of work is the same as is generally applicable to the trade.

2. Laboratory Control and Research

***Director of Research.** The Director of Research is in charge of the Laboratory and is responsible for the quality of the purchased raw materials and the finished products. He issues formulas and manufacturing instructions for all products, directs development work on new products and directs a research program.

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***Control Chemist.** The Control Chemist supervises the activities of the Control Section of the Laboratory. Thus he maintains a constant check on the quality of incoming raw materials and of finished goods processed in the plant.

***Research Chemist.** The Research Chemist supervises the work of the Research Section of the Laboratory. These activities include development of new products and processes, studies of new processing methods and the conduction of tests on new equipment. He is also responsible for the development of new analytical methods.

***Chemist.** He makes routine analytical tests on incoming raw materials as well as non-routine special analyses on raw materials and occasionally on material in process or finished goods.

†Control Technician. Several are employed for routine analyses on finished goods, measuring physical characteristics and flavor as outlined in the previous section on the Laboratory. This work requires a certain amount of care and ability to judge flavors; these requisites are developed on the job.

***Research Assistant.** Working under the supervision of the Research Chemist, he carries out research and development problems. None of the work is routine, and a certain amount of independent thinking is necessary by the worker.

†Pilot Plant Operator. He works in the laboratory pilot plant in the processing of new products that are being developed. He must be able to operate the same type of equipment as is used in plant processing.

3. Shipping, Receiving and Warehousing

†Foreman. The foreman of the department is responsible for the handling of in-and-out shipments and supervises the storage of raw materials, packing materials and finished goods. He is assisted in these duties by assistant foremen.

Stock and Shipping Clerk. He assigns Checkers and Order Men to check incoming and outgoing shipments, insures that proper stock is ready for loading, inspects loading and seals the cars.

Receiver Leader. The details of receiving and storing are handled by the Receiver Leader. He allocates work to unloading labor, receives raw material shipments, allots storage space, furnishes raw materials and packing materials from storage to the using department and keeps the records of the movements.

Checker. A Checker plans the storage and stacking in the car and sees that the proper goods are loaded. Likewise he checks unloading of in-shipments and keeps the necessary records.

Stockman. He operates a fork-lift truck in the warehouse, moving goods to and from storage and is responsible for the care and maintenance of his truck.

Order Man. The Order Man furnishes the stock from storage to the Checker for loading and checks the count on goods being moved.

4. Purchasing Department

***Director of Purchases.** This work requires a person with wide purchasing experience who can keep close contact with raw material markets for economical buying. He has charge of the purchase of all raw materials, packing materials, new equipment and necessary maintenance items.

†Purchasing Agents. They locate the sources of supply, obtain competitive prices, interview salesmen, negotiate contracts and follow up on deliveries and inventories.

5. Sales Department

***General Sales Manager.** A high-caliber executive type is needed for this position in that he must have knowledge of present and prospective markets as well as the production capabilities of his own concern. He plans and initiates the introduction of new products and sales campaigns and is generally responsible for the sales policy of the company. He is assisted by managers for grocery items, confectionery items and bulk sales.

†Advertising Manager. Almost all advertising is handled through an agency; however, a man within a concern is necessary for contact and the establishment of basic plans and ideas for elaboration and finishing by the agency.

Salesmen and Brokers. They are the personal contact between the industry and the bulk consumers. Visits are made within an assigned area to concerns requiring chocolate products, contracts are negotiated and technical assistance offered where seriously needed. They must be persons of good character with a pleasing personality in addition to a good knowledge of their product and the handling of it.

6. Controller or Treasury Department

***Controller or Treasurer.** He acts as adviser to the General Manager on all financial matters of the concern. He must keep abreast of the financial status of the company and establish fiscal policies. In short, he keeps track of how the company spends its money, suggests ways in which it can be more economical, prepares the budget for future expenditures and handles the borrowing of capital.

†Credit Manager. Any concern dealing with all types of industries, large and small, must establish a credit policy. Before allowing credit to a customer, the latter's financial status and capabilities have to be investigated. Once this is done it is up to the Credit Manager to decide whether or how much credit shall be allowed.

†Traffic Manager. The Traffic Manager must have a thorough familiarity with Interstate Commerce Commission regulations, most advantageous classification of shipments and the proper routing of movements. In addition, he should have knowledge of customs and parcel post regulations. His personality is an asset, since he contacts many outside shipping concerns.

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†**Office Manager.** His job is what the name implies — he takes care of the supply of stationery, forms, business machines and furniture; he arranges the office space in the building; he interviews personnel for office jobs and he has charge of the preparation of the pay roll.

†**Cost Accountant.** He is responsible for preparing cost estimates on the products being manufactured and on products being developed. Of course, as prices of raw materials change he must revise his cost evaluations.

†**Order and Billing Manager.** His section prepares the invoices on all shipments from the plant. Since from them the shipment is initiated in the warehouse, the papers must be started at the proper time so that the customer will receive his order as scheduled. Care and accuracy have to be maintained in order that the proper goods go to the right customer.

†**Billing Machine Operator.** She works from copies of orders or such other forms as may come from the Sales Department to prepare the invoices, bills, statements, etc., on a typewriter or billing machine. She must be familiar with the form, discounts and special details. Other work of a clerical nature may be included in this job.

†**Budget Manager.** The Budget Manager is in charge of the section established to draw up a budget of planned capital expenditures and then, as work is completed, make the charge against the budget. In short, he maintains a statistical check on the company's finances.

†**Accountant.** This job requires general accounting knowledge for preparation of standard and special accounting reports. A broad experience in accounting and the ability to read and analyze reports and statements are necessary. He generally supervises the work of Accounting Clerks.

7. Executive

***President and General Manager.** For efficient operation of a large company a very competent person is essential as the managing head. He should be thoroughly familiar with the operations of the plant and functions of the various departments as described in Section II. He should keep informed of the raw material situation, financial status of the company and sales predictions so that in business dealings and in future planning his decisions are based on the actual conditions and his own shrewd judgment.

8. Personnel Department

†**Personnel Manager.** He is concerned with all of the problems pertaining to the people employed in the company. He handles employee relations which include negotiations with the labor organization, interviewing of some job applicants and consultation on individual employee problems. He is responsible for safe working conditions and operation of the company cafeteria and medical department.

†**Safety Engineer.** Generally he is assistant to the Personnel Manager and aids him in interviewing job applicants. He makes continuous inspection

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tours through the plant for the purpose of eliminating occupational hazards. He investigates all plant accidents, determining their cause and makes recommendations for preventing recurrences. He also has charge of the educational campaign for the prevention of accidents.

†**Nurse.** The company dispensary has a registered graduate nurse on duty at all times for treating injuries and general emergency care. She is responsible for maintaining medical records of the employees and keeping first aid supplies and equipment. She may advise or assist employees in personal medical problems.

9. General

†**Secretary.** She acts as private secretary to a top official. She must be able to take dictation and transcribe on a typewriter from shorthand notes or from a dictating machine, prepare letters from notes or verbal instructions, arrange meetings and do routine clerical work. The quality of her work should be such that it does not have to be checked closely.

†**Secretary-Stenographer.** Her work is much the same as that of the Secretary except that she does not have as much responsibility and operates under more supervision. She generally acts as a secretary for several members of the same department.

Switchboard Operator. She operates a standard type switchboard, handling incoming, outgoing and intra-company calls. She keeps a record of toll calls. An efficient, courteous and cheerful type of person is most suitable for this job.

Mail Clerk. He opens and distributes all incoming mail, collects and distributes intra-plant correspondence and sorts and stamps all outgoing mail.

C. Entry into the Field

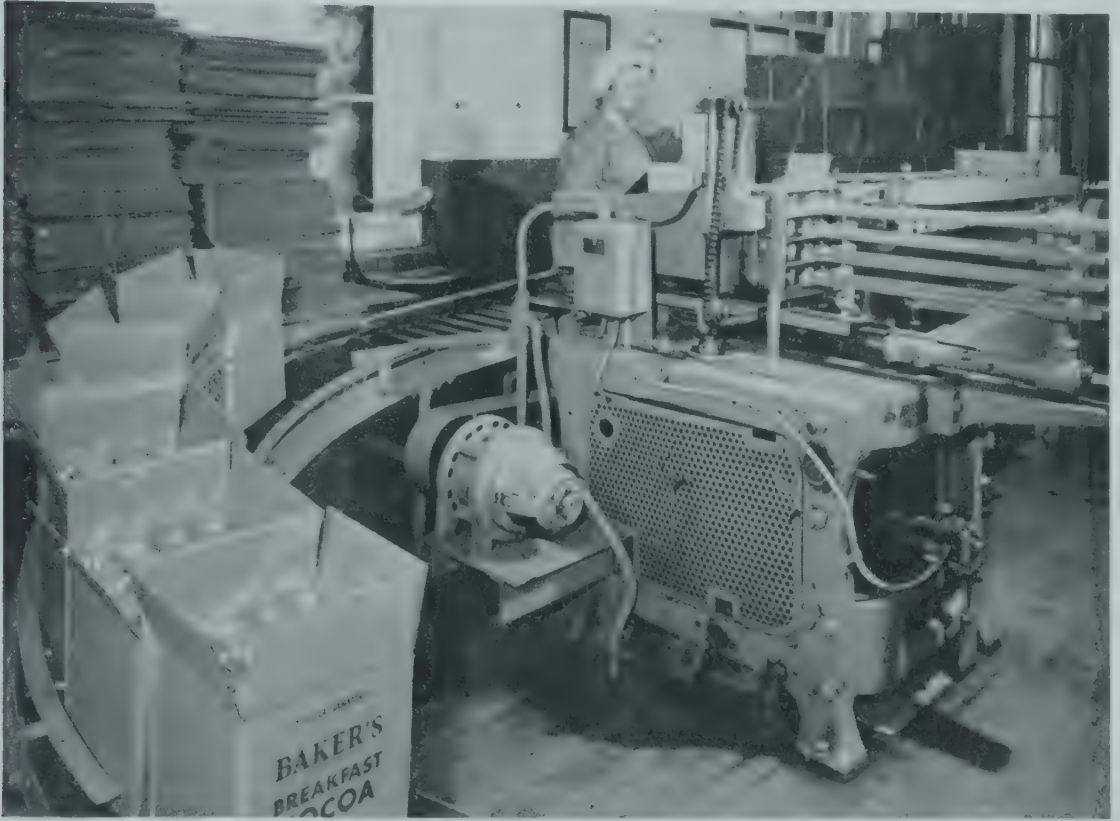
With such an array of jobs as described above the question arises as to how such jobs may be secured. Unquestionably many of the jobs outlined on previous pages must be learned in the plant from experienced operators. In many instances, however, there are jobs which are common to other industries such as those in the office or in the mechanical department where a skilled person may be employed directly for the particular opening.

In most organizations it is the practice to promote qualified personnel from within the company to higher positions as openings occur. Since there are few people experienced in the manufacture of chocolate who are seeking jobs, such a practice is almost a necessity in the chocolate industry. Usually beginners in the chocolate plant are hired as general labor and in such a position may serve as assistants where they can learn a skilled job. In many plants promotions are based on seniority as vacancies occur. Of course, when a vacancy does occur the man must be qualified to handle the job.

In the laboratory a man is hired primarily for his scientific background, and he must develop his chocolate knowledge through experience. As a result he generally starts as a Control Technician or Chemist and progresses as openings

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occur and his capabilities indicate. It is an opportunity for a technical person to obtain a good training in chocolate manufacture because the laboratory deals with all phases of the processing and investigates any problems that arise.



Packer tending casing machine for half pound cans of cocoa.

For office jobs people are hired with training in the various professions that are common to all businesses. Secretaries, clerks or accountants, for example, require no special training in chocolate other than a familiarization with the terms used, as would be the case in any business. However, salespeople need some education on the characteristics of the product.

Since the chocolate industry essentially is not a seasonal business as far as employment is concerned, one cannot set a time at which jobs are most readily available. Peak demands for some items may come at different times than others. Consequently, applications for jobs should be made at a company to determine the employment situation. If no openings are available at that particular time, it generally is possible to file an application or determine the outlook for the future.

V Geographical Location

Prior to the advent of commercial refrigeration the large-scale manufacture of chocolate tended toward a moderately cool section of the country in order to take advantage of the correct climatic temperature for solidifying chocolate. With

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the development of efficient insulation and artificial cooling methods it is possible for the industry to operate profitably in any section of the country.

As in the case of any large concern, a supply of cheap power, an available labor supply and good transportation facilities are three important factors in selecting an industrial site. Location near the source of raw materials is another economic advantage, but in the case of chocolate this is not possible, since practically all of the raw materials except milk are produced outside the United States.

Good transportation facilities are most important because of the large quantities of raw materials to be moved to the plant. All of the cocoa beans are grown outside the United States and come by boat to coastal ports from which they are moved to the chocolate plant. Most of the sugar comes from foreign countries and is processed in refineries which are located generally along the coast from which it is distributed to the user. The finished chocolate products are usually sold over a large area. Therefore, a dependable source of transportation must be readily available for moving raw materials in and finished goods out.

The power requirements are not excessively large. Electricity is used for turning practically all machines, such as roasters, grinders, conveyer belts and compressors, while oil or coal must be available for producing the steam used for heating purposes.

From the above analysis it can be seen that there is no drastic limitation geographically as to the location of the manufacturing site. It is admitted that some sections of the country have definite advantages over others; however, for the advantage which one section may possess, another locality may have a different and off-setting sales point. A survey will show that the present chocolate producers are located all the way across the country, although they are mostly concentrated near the heavily populated areas which have a large labor supply and represent a large potential market.

VI Recommended Scholastic Training

No college courses are given which are devoted solely to cocoa and chocolate manufacture, but there are innumerable subjects which pertain to various phases of the industry. Those which give a well-rounded background should be pursued, and then a knowledge of chocolate processing can best be built through experience and training on the job. Even after a person has completed a formal schooling and spent some time in the industry he finds it to his advantage to go back for additional study in subjects relative to the phase he is pursuing or to take refresher courses to learn about newer developments.

The food industry in general, chocolate processing included, is a relatively new field for technological improvements. For many years processing has been governed more or less by rule of thumb and with the aid of the senses of taste, touch and smell. A satisfactory product was quite often made by cut and try methods. Once a good product was manufactured, those manufacturing conditions were arbitrarily set; however, studies were not made to determine the most efficient way of doing things or why certain results were obtained. Consequently, during the past 20 to 25 years more and more technical personnel have been hired for study of food processing.

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Colleges are coming to realize to a greater degree the value of a basic course for those planning to enter a food industry. To fill the need, some schools already have established courses in food engineering or technology on the same basis as courses in electrical or chemical engineering. Other schools are limited to individual subjects on food processing or food technology carried in some such department as chemistry, bacteriology, engineering or agriculture. Through collaboration with the industry, the schools of the country are learning how they can provide a suitable education for people interested in entering the food industry. Since the industry has so many branches, the best that can be done is to provide a good general education on foods as a foundation and allow for specialization by training on the job.

In recommending courses of study for anyone intending to enter the Chocolate Industry, it is considered advisable to suggest one which will give a general background for the food industry as a whole. Most important is a good understanding of the various branches of chemistry: inorganic and organic chemistry, qualitative and quantitative analysis, physical chemistry and even a knowledge of colloidal chemistry would be an advantage. Bacteriology, with emphasis on the industrial use of bacteria as in the fermentation industries, is of value. A study of biochemistry should be made for the information on food analysis and the functions and uses of enzymes.

Two courses which come under the province of chemical engineering are essential. First is a study of so-called unit processes which include evaporation, distillation, heat transfer, grinding, filtration and many others. Practically every process industry is concerned with one or more of these operations. In the Chocolate Industry, to mention a few, are grinding, heat transfer, mixing and air conditioning. Secondly, a study of the principles of thermodynamics will be of great assistance for those concerned with the engineering phase of the industry. If such a course is available, one relating to equipment design, control instruments and packaging machinery would be very worth while.

Above have been listed briefly some of the subjects most important to anyone intending to make the technical side of the food industry his life's work. The list is by no means complete, but is intended only as a guide. The curriculum must be filled out with basic subjects, such as higher mathematics, physics and cultural subjects. Detailed descriptions of the individual subjects are not made here, since they may be found in any college catalog.

The jobs in Section IV indicated as requiring technical school or business administration training point to an entirely different phase of schooling which is self-explanatory. The individual trains as a stenographer or accountant or learns the specific trade of a machinist or welder. These jobs are common to all industries. The catalog of any good secretarial, business or technical school will list in detail the necessary curriculum.

Most of the manufacturing jobs in the plant do not require any previously trained skill. The operator learns the job by training on the spot, generally by serving a certain amount of time as an apprentice or assistant to an operator. Development of the ability to taste for checking flavors, as an example, certainly is a skill which comes only from practice.

The old axiom, "Experience is the best teacher," holds true in this industry just as in so many others. The trade may bear some similarities to other occupa-

tions, but it has its unique characteristics which are understood only from personal experience.

VII Remuneration

Employees in the Chocolate Industry are not over-paid by normal standards, but neither are they underpaid for their labors. Their working conditions are good in that there are no more occupational hazards than in any other industry that uses heavy machinery. In addition to their regular pay the employees are eligible to participate in group insurance and retirement plans in which the company shares a portion of the expense.

Recently a wage and policy survey of hourly-rated employees was made of some of the larger chocolate manufacturers. On the basis of the survey the following paragraph is given as an average picture.

The employees, represented by a union bargaining agent, negotiate a yearly contract with regard to working conditions, wages, seniority and related matters. The minimum hiring rate averages \$41.20 per week for men and \$34.40 for women, based on a 40-hour week. After these people have been trained on the job, they rise to a minimum fully qualified job rate average of \$45.00 per week for men and \$36.60 for women. Of course, as the person gains experience and advances to other jobs, his pay rate increases accordingly. In addition to the established job rate, employees in certain jobs are eligible to work on an incentive bonus plan. All employees working on other than the day shift receive a differential over the above rates. When it is necessary to work over forty hours per week, pay is at time-and-a-half. Paid vacations are supported by the company, the length of the vacation depending on the time the employee has been with the concern.

Another study, not made of the concerns above but in an individual company, shows the progression of the wage scale commensurate with the increase in skill. Limited to hourly-rated jobs in the processing departments, they have been classified into five groups on the basis of rate of pay and degree of skill; then the pay rates have been averaged in each group. The first category, Common Labor, averages \$1.05 per hour. This is for jobs which require no experience and very little training. In the next grouping, Trained Labor, more time is required for training, and longer experience is necessary for such jobs as Mixers and Depositor Operators. Rates on this level average \$1.10 an hour. Semi-skilled labor (for example, Stockmen, Tempering Operators and Mill Operators) receive \$1.15 an hour. Skilled help who have had long training and experience on the job, such as Bean Roasters, Stock and Shipping Clerks and Standardizers, average \$1.20 per hour. A special category called Skilled Plus Special Requirements is paid \$1.29 per hour and takes in such jobs as Assistant Foreman in Training and Refiner Leaders. The above are basic rates only, and incentive bonuses and night differentials are additive.

Apart from the above schedule of hourly rates is the scale of hourly-paid employees in the maintenance shops, power house and refrigeration plant. On the basis of required training and experience for their particular trade, they are paid on a different scale from the process operators. They are not subject to the incentive bonuses but only to the shift differential.

Personnel in the offices and laboratory are paid on a straight weekly salary basis. This salary is based on several factors: the importance and requirements of

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the job, the employee's qualifications, such as training and experience, and the average wage normally paid by other concerns in the same locality for equivalent jobs. As a general picture of a few of the jobs, the following figures are quoted on a weekly basis. Secretaries start at \$35 to \$37; those who work for top officials (general managers and department heads) may make as high as \$56. These holding a slightly lower status which does not require quite as much responsibility or initiative have a top limit of about \$47. Stenographers, Business Machine Operators and Clerks generally start near the Minimum Wage Act figure of \$30 and may advance to \$44, \$47 and \$35 per week respectively. Depending on their previous training and experience, Draftsmen start at about \$42 per week, and \$100 to \$115 is about the top limit. Laboratory Technicians receive in the neighborhood of \$43 to \$60 per week depending on their qualifications and experience.

All of the above wage scales quoted are not meant as fixed values and, therefore, should be taken only as a general gauge. The figures quoted here are based on conditions existing April 15, 1949, and are subject to the changing economy. A company pays wages based on numerous factors too complex to go into here. The main thing, of course, is the value to the company of the job done. The employer always can pick out the people who work hard, do a good job and are worthy of advancement or pay increases. Therefore, no pay scale should be considered as frozen; the individual will be paid on his merits.

VIII Opportunities for Advancement

In any industry a person's chance of advancement is based on two main factors: the individual's own ambition, aggressiveness and aptitude and secondly on the growth and progressiveness of the concern or industry itself. When either one or the other stagnates, the individual will find that his position does not improve and may become poorer.

No man can go farther than he wants to, and certainly no one is going to force him into a job for which he is not fitted. He might be given a chance to fill a better job but if he cannot produce, he most assuredly will not remain long. The person who has the ambition to get ahead will take advantage of every opportunity to improve his knowledge and thus to qualify himself for advancement. Seldom do an individual's efforts go unobserved, for really good workers are hard to find, and management is always watching. Education is important in the requirements for filling a job up to a point; then it is the individual's own experience and aggressiveness which mean more toward advancement.

Progressiveness, and from it growth of the industry, is important if the individual in the concern is going to advance in that field. The Chocolate Industry can point to numerous factors indicating its progressiveness. The consumption of cocoa beans in the United States continued to increase year after year up until World War II. A decline then was due to the shortage of ships to bring cocoa beans from the tropics. It is expected that the consumption will increase again and surpass previous usage.

The industry is continually studying ways of improving its products, its methods of manufacture and the development of new products. These are all factors which tend toward more jobs, and with more jobs there are greater chances for desirous persons to improve their positions.

IX Opportunities for Both Men and Women

The greater percentage of the jobs in the industry are held by men since they involve running heavy equipment, performing manual labor and technical skills in which few women attempt to compete. However, this does not mean women could not handle some of these jobs, as was demonstrated in the last national emergency.



Packers placing chocolate bars from wrapping machine into cartons.

Nevertheless, there are numerous opportunities for women, both skilled and unskilled. In the plant they operate wrapping machines, pack goods from conveyor belts and tend filling machines. In the laboratory they work as chemists and technicians. Large numbers are employed as secretaries, stenographers, clerks, business machine operators, bookkeepers, receptionists and switchboard operators. It is not impossible that some women with special aptitudes might get into executive jobs in fields such as advertising and sales.

X Advantages and Disadvantages

A. Advantages

1. The industry operates on a year-round basis. Cocoa bean crops come in at different times of the year, but they can be stored without detriment.

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2. The occupation is not hazardous. Although heavy machinery is used, it is guarded adequately and is not considered dangerous except to the careless.

3. The products with which one works are not dangerous or offensive. Occasionally a person may have an allergy to cocoa powder, but this is very seldom.

4. It is a growing industry. A study of the yearly statistics on the production of chocolate shows that the quantities of cocoa beans produced and the amount imported by the United States have increased almost yearly.

5. There are opportunities for a large number of different types of skills such as chemists, draftsmen, salesmen, secretaries, engineers, machinists and accountants, with widespread opportunities for advancement for all.

6. Development of new products and new process methods is a large field which is open for unlimited exploitation. New products with sales appeal are always in demand in any progressive company. Improvement of production methods is a project on which more work can always be done.

B. Disadvantages

1. The monotony of some individual jobs.

2. Working conditions of a few jobs may be disagreeable to some employees. Because of the nature of the product, temperature is an important factor in processing. Some equipment must run at elevated temperatures, which results in people working where the room temperature is higher than normal. Others working on packing lines must work in rooms which are maintained close to 65°F. all of the time. These working conditions are not objectionable to many individuals, in fact they actually prefer them.

3. A few jobs require working under dusty conditions. When cocoa powder is in its finished form, it is very difficult to contain and will sift through the tiniest crack or crevice. Consequently, jobs in this location tend to be dusty and dirty, although this is not objected to by most employees.

XI Contribution to the Public Welfare

The Chocolate Industry plays an important part in the food habits of the people of the country. The products are extremely popular for their characteristic flavor, both independently and when used in combination with other foodstuffs. Chocolate products are valuable not only for the flavor which they impart, but also for their own contribution of nourishment to the human diet.

Since its inception chocolate has long been popular as a flavor. The chocolate products we know today may differ tremendously from those made 150 years ago, but the basic flavor is still much the same. Enormous quantities of chocolate go into confectionery items, cakes, icings, puddings, cream pies and ice cream. That the quantity is increasing every year is further proof of its popularity. One example of its popularity is shown by a survey wherein for every 100 cakes of all kinds other than chocolate made, the housewife baked 53 chocolate cakes.

The food value of chocolate has long been recognized. Records of the early explorers testify to its nourishing effects. However, the most recent example is its use by the U. S. Army as an emergency ration during World War II.

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Unsweetened chocolate has an average analysis of 53% fat, 12% protein, 25% carbohydrates, 3.5% ash, 1.5% moisture, 1.5% theobromine and 3.5% fiber. Cocoa, likewise nourishing, has an average analysis for the breakfast grade of 22% fat, 20% protein, 41.5% carbohydrates, 5% ash, 3.5% moisture, 2% theobromine and 5% fiber.

Milk is recommended for its nourishing qualities and its special value in the adolescent diet. Many children take a violent dislike to milk, but with the addition of cocoa or chocolate this aversion has been overcome. Today "chocolate milk" is very popular as a beverage for young and old.

XII Future

Although chocolate has been known for several hundred years, the more it is studied, the more people find how much there is to be done to improve the product. By learning more about the chemical and physical structure of the cocoa bean, new and more efficient ways can be found to treat it, and new products may be developed.

As an outcome of World War II chocolate manufacturers find they have a great deal to do in the design and development of new processing equipment. Prior to the war Germany was internationally known for its design and fabrication of chocolate processing equipment, some of which it supplied to the world. In the present state of affairs it may be a long time before Germany will again be manufacturing chocolate processing machinery. In the meantime present equipment is wearing out. Consequently, the Chocolate Industry has the job of adapting other machinery or designing new equipment to fit the requirements. This does not mean that the industry will suffer for lack of German equipment; in fact, the shortage will result more likely in great improvements in present techniques.

The development of new products is always open for more work. Cocoa and chocolate are well established, but introduction of new types of products containing them is going on continuously. In the past ten years two new products have appeared which have had great sales success: instant cocoa, which needs only water added to make a chocolate beverage and a ready-prepared chocolate syrup.

New merchandising methods is another field which must be constantly followed. Sales are the backbone of any industry; therefore, studies should be made to find new and improved techniques for keeping the public informed of the products and presenting them with both the information and the product in an appealing manner.

From the brief synopsis above it can be seen that there is no reason for the Chocolate Industry to stagnate. It has plenty of work for the coming years to continue its expansion and its presentation to the consuming public with an ever-improving product.

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XIII Professional Organizations

The Chocolate Industry has no professional organizations of its own. On the other hand, there are many technical organizations which discuss problems and developments that are of interest to chocolate producers.

Institute of Food Technologists, Executive Secretary, Suite 954, 222 W. Adams St., Chicago 6, Ill.

American Chemical Society, 1155 16th Street, N. W., Washington 6, D. C.

American Dairy Science Association, R. B. Stoltz, Secretary-Treasurer, Ohio State University, Columbus, Ohio.

Association of Official Agricultural Chemists, Inc., Box 540, Benjamin Franklin Station, Washington 4, D. C.

American Institute of Chemical Engineers, Secretary, Bellevue Court Building, Philadelphia, Pa.

American Association of Candy Technologists, Secretary, 15 Lombard St., Philadelphia, Pa.

XIV Professional Publications

As in the case of professional organizations, the Chocolate Industry has no publications devoted solely to chocolate. Here, too, it is dependent on publications of other organizations and trade papers for the publishing of technical information. Listed below are a few of these publications.

1. "Food Research," The Garrard Press, Champaign, Ill.

2. "Journal of the Association of Official Agricultural Chemists," Association of Official Agricultural Chemists, Inc., Box 540, Benjamin Franklin Station, Washington 4, D. C.

3. "Journal of Dairy Science," American Dairy Science Association, The Science Printing Co., Lancaster, Pa.

4. "Food Industry," McGraw-Hill Publishing Co., Inc., 330 W. 42nd St., New York 18, N. Y.

5. "Food Materials and Equipment," Food Information Publishers, 232 Madison Avenue, New York 16, N. Y.

6. "The Manufacturing Confectioner," Manufacturing Confectioner Publishing Company, 400 W. Madison Street, Chicago 6, Ill.

7. "Industrial and Engineering Chemistry," American Chemical Society, 1155 16th St., N. W., Washington 6, D. C.

8. "Chemical and Metallurgical Engineering," McGraw-Hill Publishing Company, Inc., 330 W. 42nd Street, New York 18, N. Y.

9. "Gordian," Hamburg, Germany.

10. "Cacao Information Bulletin," Cacao Center, Inter-American Institute of Agricultural Sciences, Turrialba, Costa Rica.

11. "Food Technology," Institute of Food Technologists, Suite 954, 222 W. Adams St., Chicago 6, Ill.

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